Dunkley Lumber Ltd.

Tree Farm Licence 53
Type 1 Silviculture Investment Strategy
Final Report
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The purpose of this report is to update the Tree Farm License 53 (TFL 53) Silviculture Strategy (June 2002) completed by Forest Ecosystem Solutions Ltd. The workshop and this report were commissioned by the Ministry of Forests and Range, Forest Practices Section, in September 2005. The project was completed by Forest Ecosystem Solutions Ltd. (Antti Makitalo RPF) and B.A. Blackwell and Associates Ltd. (Rob Sandberg RPF) under contract no. 500655LVT077.

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Input from the following participants is gratefully acknowledged:

Name	Organization
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EXECUTIVE SUMMARY

This document presents an updated Silviculture Investment Strategy (SIS) for Tree Farm Licence (TFL) 53 managed by Dunkley Lumber Ltd. The purpose of the strategy is to guide the application of available incremental silviculture funds toward the most efficient and effective treatment programs. The main focus of the strategy is incremental silviculture; however, some basic silviculture activities are addressed where appropriate.

A silviculture investment strategy was produced for TFL 53 in June 2002. Due to significant changes that the mountain pine beetle (MPB) epidemic has caused in the timber supply situation of the tree farm, the Ministry of Forests and Range (MOFR) commissioned this Type 1 SIS. This strategy is funded by Forests for Tomorrow (FFT) and is primarily intended to deal with intensive and backlog silviculture opportunities and reforestation of dead stands (pine and spruce), which will not be salvaged.

The strategy is guided by the principles contained herein and by those of the *Incremental Silviculture Strategy for British Columbia*.

General Objectives

The objectives of this silviculture strategy are:

- Mitigate the effects of the MPB epidemic on the timber supply
- Manage the fire risk to timber supply caused by the MPB epidemic
- Review Basic Silviculture Practices in the Context of the MPB Epidemic and Future risks of Pests and Diseases
- Keep options open for the future
- Quality considerations: maintain or increase the quality of timber supply.

Major Silviculture Strategies

Basic Silviculture

- Continue to minimize the current NSR by quick planting after harvesting.
- Continue to use mechanical site preparation, where needed, to create plantable spots and improve rooting conditions for the planted seedlings. Excavator piling is used to create plantable spots and mounding is used to warm soils and improve drainage.
- Continue to use seed orchard stock for all spruce seeding requirements.

- Continue to plant high densities of mixed species (1,800 – 2,000 sph) to:
    - Provide high site occupancy and high potential for growing wood fibre;
    - Reduce risk of plantation failure;
    - Create opportunities for commercial thinning.

- Continue to use effective and timely vegetation management to promote better survival and growth of seedlings.

Incremental Silviculture

The proposed incremental silviculture strategy for Dunkley Lumber Ltd consists of:

<u>Fertilization</u>

Fertilize mature spruce - leading stands to generate short-term volume gains and larger log sizes. The estimated 5-year fertilization area is 1,000 ha. The projected cost over 5 years is $425,000.

Fertilize immature spruce - leading stands to generate medium-term volume gains. Repeat stand treatments are preferred. Pine-leading stands should be incorporated in the ongoing review of candidate stands for treatment once the MPB epidemic subsides. The estimated 5-year fertilization area is 7,000 ha. The projected cost over 5 years is $2,975,000.

<u>Non- Merchantable Stand Reforestation Strategy</u>

Ensure the prompt regeneration of all NRL sites. Most of these are expected to be non-merchantable pine stands. An *NRL survey program* will identify problem sites and result in the prioritization of treatment areas.

Other NRL management considerations should include:

- Actual and expected natural infill by ecosystem
- Potential NRL treatment strategies considering biological, economic, feasibility and safety factors
- Seed needs to support potential artificial reforestation efforts
- Fire protection strategies
- Non- pine species retention strategies
- Potential development of a decision matrix for use in field assessment of NRL's

The NRL survey program is projected to cost $30,000 over the next 5 years. The estimated costs to reforest the NRL areas in the TFL are $1,500,000 over 5 years.

Backlog Surveys

- Continue implementation a TFL 53 Backlog Survey program to identify treatment opportunities and to monitor effectiveness. The budget for the next 5 years is $9,000.

Backlog- Impeded Stand treatments

- Implement cost effective backlog – impeded stand treatments as required. It is estimated that there are approximately 400 ha of impeded stands requiring treatments over the next 10 years. The total cost over 5 years (200 ha) is estimated at $160,000.

Non- Status Roads treatments

- Rehabilitate and reforest previously identified non - status roads. The estimated are requiring treatment is 50 ha with the cost of $170,000 over 5 years.

Establish a seed orchard to produce genetically improved pine seed.
(not included in the attached budget)

Short-term employment resulting from the proposed silviculture strategy would total 4,500 person days.

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1 Introduction

Incremental silviculture is part of a suite of management strategies that can have a significant influence on the future quality and quantity of the timber supply.

A Type 1 Silviculture Investment Strategy (SIS) identifies issues, objectives, and treatment regimes using the most recent timber supply analysis and other existing data. The strategy is workshop based. A Type 2 SIS uses in-depth stand and forest-level modeling to further develop Type 1 strategies. Since the advent of the Forest Renewal BC (FRBC) Program, silviculture investment strategies have been completed in most management units in BC and have become the basis for public investments in incremental forestry.

A combined Type 1 and 2 SIS was produced for TFL 53 in June 2002. Due to significant changes that the mountain pine beetle (MPB) epidemic has caused in the timber supply situation of the tree farm, the Ministry of Forests and Range (MOFR) commissioned this Type 1 SIS. This strategy is funded by Forests for Tomorrow (FFT) and is primarily intended to deal with intensive and backlog silviculture opportunities and reforestation of dead stands (pine and spruce), which will not be salvaged.

Subsequently, the MPB epidemic has grown substantially and is having a significant impact in the TFL and the surrounding management units. In 2003 the annual allowable cut (AAC) was increased from 239,500 m^3 to 500,000 m^3. Another timber supply review completed in 2005 resulted in another AAC increase to 880,000 m^3. The accelerated short-term harvest and mortality due to the pine beetle infestation affect the mid-term harvest level in the TFL. Recent analyses have shown these impacts to start as early as 7 years from now.

Due to the broad, integrated nature of silviculture and the magnitude of the MPB epidemic, there is also a need to consider and integrate other existing or planned mitigation initiatives. For example, the recently announced federal program on interface fire hazard abatement, ecosystem restoration, inventories and research and development needs to be considered. In addition, basic silviculture strategies, forest fire protection and strategic interventions to promote the salvage of specific stands should be considered. The key overall goal is to use this SIS update process to provide as much integrated, strategic direction to MPB mitigation as possible.

1.1 Methodology

The following process was used to prepare this strategy:

1. Identification of the key issues that should guide silviculture planning in TFL 53. Analysis of the most recent timber supply information and assumptions.

2. Review and, where necessary, revision of the existing objectives relative to the key issues.

3. Review the existing key silviculture strategies and, where necessary, revision or deletion of regimes or development of new regimes to address the revised objectives and key issues.

4. Evaluation of the key scenarios and selection of a preferred strategy.

5. Development of an updated 5-year incremental silviculture program.

6. After licensee review, the consultants submitted the completed strategy to the MOFR.

A workshop, to facilitate the key aspects of the report, was held in the Dunkley Lumber Ltd boardroom on January 5, 2006. The sessions were lead by Antti Makitalo RPF of Forest Ecosystem Solutions Ltd. (FESL) and Rob Sandberg RPF of B.A. Blackwell and Associates Ltd. (BAB). Participants reviewed and discussed the key issues and objectives and helped identify or refine treatment opportunities.

1.2 Growth and Yield and Financial Analysis

As this is a Type 1 project, very limited analysis was completed in the preparation of strategies. Stand-level growth and yield and financial analysis of selected regimes were used to discuss and help rank the most viable treatment options. Forest-level impacts of the key regimes were estimated using the stand-level responses and the estimated opportunity areas.

TIPSY (version 3.2) was used for stand-level growth and yield using inputs and assumptions from the most recent timber supply review and current forest practices.

For stand-level financial analysis the net present value (NPV) approach was used. The NPV of a treatment regime is the sum of its discounted revenues minus the sum of its discounted costs. By calculating NPV, treatment regimes with costs and revenues at different points in time can be compared. Limited sensitivity analysis was performed to show the impacts of changing key cost, revenue and discount rate assumptions. The appendices to this report include the key formulas, cost, revenue and employment assumptions that were used.

2 Summary of Basic Data and Timber Supply and Silviculture History

Information for this report was drawn from the following sources:

- Rationale for Allowable Annual Cut Determination. British Columbia Ministry of Forests and Range, October 2005.
- Timber Supply Analysis Report in support of Management Plan 4. Industrial Forestry Service Ltd., February 2004
- Timber Supply Analysis Information Package in support of Management Plan 4. Industrial Forestry Service Ltd., August 2003.

2.1 Basic Data

The timber harvesting land base in TFL 53 is 68,644 ha. Table 1 shows how the total TSA area of 87,693 ha is classified into Crown Forest, non-forest, non-timber harvesting land base (NTHLB) and THLB. A more detailed netdown is provided in the documents mentioned above.

Table 1 - Land Base Netdown (MoFR, 2005)

Total TSA Area	87,693 ha
Non-forest or not Crown	8,056 ha
Crown Forest	79,637 ha
NTHLB	10,993 ha
THLB	68,644 ha

Most significant netdown factors in the TFL that reduce the THLB are:

- Riparian 2.24%;
- Problem forest types 4.13%;
- NP 1.77%;
- ESA 1.65%;
- Roads trails and landings 1.55%.

Spruce-leading stands cover approximately 58 % of the THLB, while the share of pine leading and balsam-leading stands is 26% and 8% respectively (Figure 1).

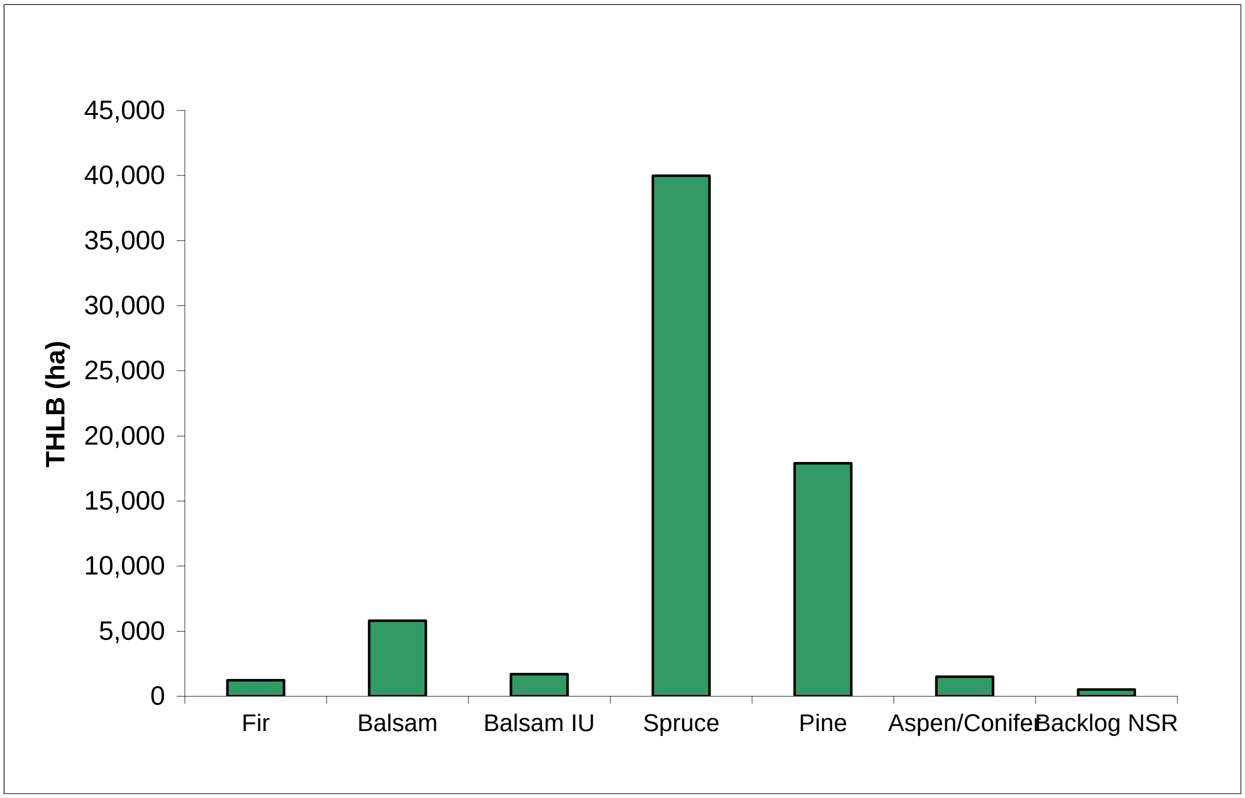

Figure 1 - Leading Species in the THLB. Source: IFS 2003

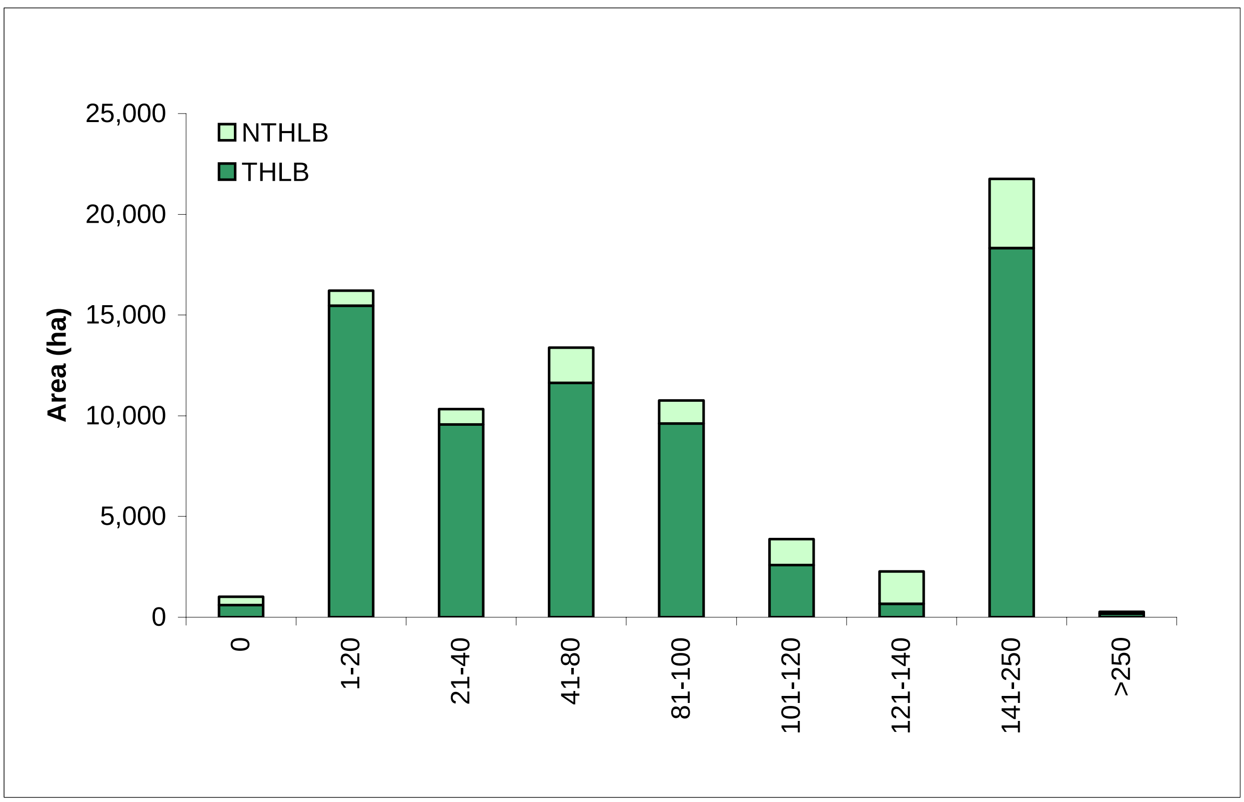

Figure 2 - TFL 53 Age Structure. Source: IFS 2003

Figure 2 illustrates the current age structure of the TFL. The age class distribution is reasonably balanced with no significant age class gaps.

The SBS types dominate the BEC variants in TFL 53 with the most common being SBSmk1, SBSwk1, and SBSmw1. They account for almost 89% of the THLB. The share of ESSFwk1 is approximately 11% (Figure 3).

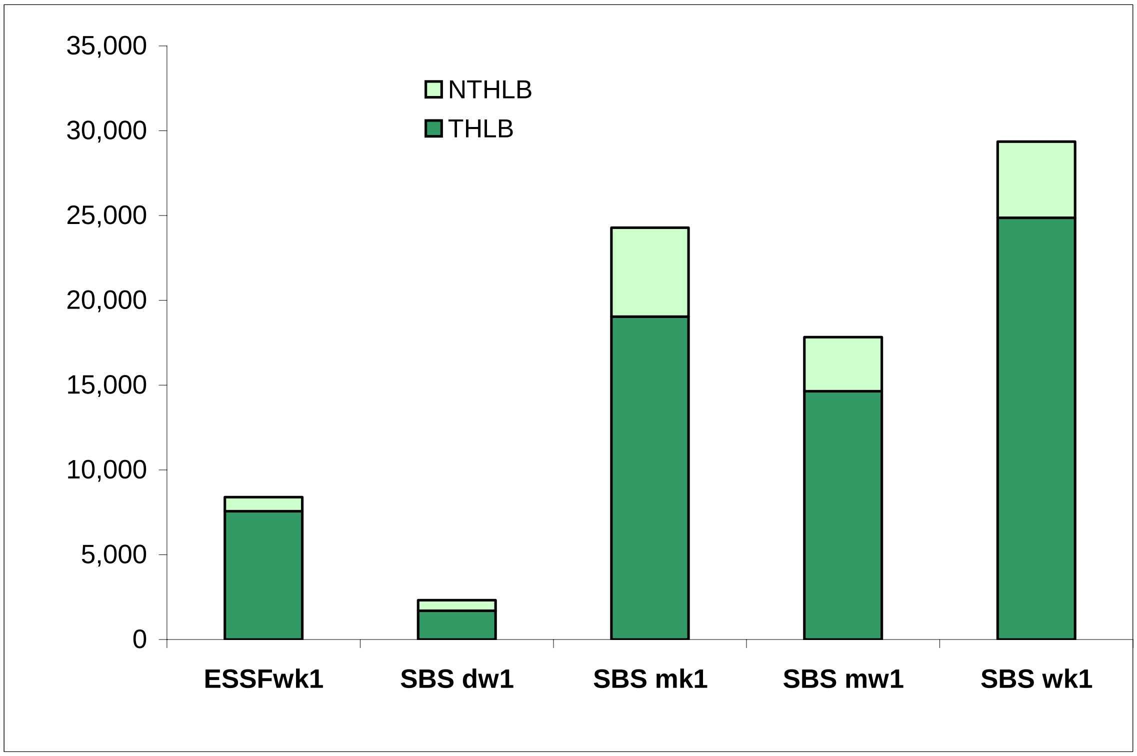

Figure 3 - BEC variants in TFL 53. Source: TFL 53 Terrestrial Ecosystem Mapping

The growing sites on TFL 53 are productive. The long-term harvest level indicates an average mean annual increment (MAI) of 3.75 m^3/ha/year.

2.2 Timber Supply

2.2.1 History of the Allowable Annual Cut

TFL 53 was established in 1989. Since its creation the AAC has been determined several times (Table 2). The last two determinations (2003 and 2005) increased the AAC significantly to facilitate timely harvest of mountain pine beetle killed stands. The current AAC of 880,000 m^3 per year was set on October 19, 2005 for 3 years. On October 20, 2008 the AAC will be reduced down to 219,000 m^3 per year.

Table 2 - History of the AAC in TFL 53 (IFS, 2004)

Year	AAC m^3	Notes
1989	187,630 m^3/yr	
1994	204,700 m^3/yr	
1999	239,500 m^3/yr	
2003	500,000 m^3/yr	Facilitate harvest in pine leading stands, MPB salvage
2004	497,703 m^3/yr	Reduce AAC by 2,297 m^3/yr, Forestry Revitalization Act
2005	880,000 m^3/yr	Facilitate harvest in pine leading stands, MPB salvage. From October 20, 2008 the AAC will be reduced to 219,000 m^3/yr.

2.2.2 General Timber Supply Considerations

Timber supply projections are generally subject to uncertainty. Some of the typical uncertainties pertain to the actual size of the THLB, the current inventory, and the growth and yield of existing and future stands, to mention just a few. The uncertainties in the current situation are exacerbated by the MPB epidemic.

Key MPB uncertainties in the recent timber supply analysis include:

- Are the pine beetle infested stands salvaged as per assumptions?

  Timber supply analyses generally assume that a certain volume of beetle-infested timber will be salvaged during its shelf life. The salvage volumes are assumed to be significant and any large shortfalls in salvage will impact the medium term timber supply profoundly. Access and cost issues may prevent salvage in some cases, while in others there may not be adequate mill capacity. This is likely an issue for most of the management units affected by the MPB.

- What happens to stands that are not salvaged?

  We call these non-recoverable losses or NRLs. Timber supply analyses usually assume that these stands regenerate naturally within an extended regeneration lag. However, at this time it is not known what this lag is and how it varies by site conditions. Prompt rehabilitation of these NRL areas would be advantageous to the society at large. This issue will be discussed at length later in this report.

- What will happen to mixed stands where all pine has been killed?

  Depending on the species composition of these stands they may still be economic to harvest, however some or many may not be. The stands that are uneconomic to harvest may remain unproductive and need to be rehabilitated.

- What is the shelf life of beetle killed timber?

The shelf life of beetle-killed timber appears to vary depending on the climatic conditions and the types of forest products the timber could provide for. What the shelf life is within the different management units and site types is not known.

- How long will the beetle infestation last?

  Some timber supply analyses have assumed no further spread of the beetle. Other analyses have assumed that the infestation will last several more years, in some cases up to 2024, or until all the susceptible pine is dead. Clearly this uncertainty is significant because of its potential implications. If the pine beetle infestation were to stop immediately, those management units with relatively little current attack would be spared from the potentially devastating mid term timber supply and economic impacts.

There is more certainty regarding the spread and the impacts of the MPB in TFL 53. In 2005 80-90% of pine 60 years or older was either attacked or dead. By 2006 all pine in moderate or high-risk pine stands is expected to be dead.

- Is it reasonable to assume that the pine beetle attacks only mature pine leading stands?

  Most analyses attempting to predict the impacts of the beetle infestation have assumed that only pine leading stands greater than 50 or 60 years of age have been attacked. Throughout the pine beetle impacted managements units there are observations that the pine beetle has attacked significantly younger pine stands (eg. 30- 50 years old). It is not known how widespread the attack on younger stands is. However, the potential impacts can be fundamental as we rely on many of these stands for the mid term timber supply.

Heightened uncertainty due to the MPB epidemic emphasizes the importance of current forest practices and their success in maintaining a predictable fiber flow. Current silviculture practices are used as assumptions in timber supply investigations and thus have an impact on our understanding of future timber supply trends. If basic silviculture does not work regarding quantity and quality of timber, even the more pessimistic timber supply forecasts may be optimistic. For this reason, an assessment of basic silviculture practices and their success was included in all workshops. This strategy will discuss basic practices where necessary and propose changes where current practices are not deemed to produce acceptable results.

2.2.3 Timber Supply Forecast

As noted previously in this report, the Chief Forester has determined the AAC for TFL 53 twice within the last 3 years (2003 and 2005) to address salvage of beetle-infested stands.

The latest analysis that took place in 2004 and 2005, predicted a mid term harvest of 226,000 m^3 per year in the base case.

(Figure 4) shows two predicted harvest flows: Base case starting at the harvest of 500,000 m^3 per year (the pre 2005 AAC) and a sensitivity analysis with a further accelerated harvest of 800,000 m^3 per year to salvage MPB impacted stands. The sensitivity analysis illustrates that the mid term timber supply is only slightly affected by the increased short-term harvest, as there is only a 3% reduction in the timber supply compared to the base case (226,000 m^3 vs. 219,000 m^3). The long-term differences are also negligible. Note that the increased short-term harvest reduces the NRL areas, as stands that otherwise would die and remain unsalvaged are harvested.

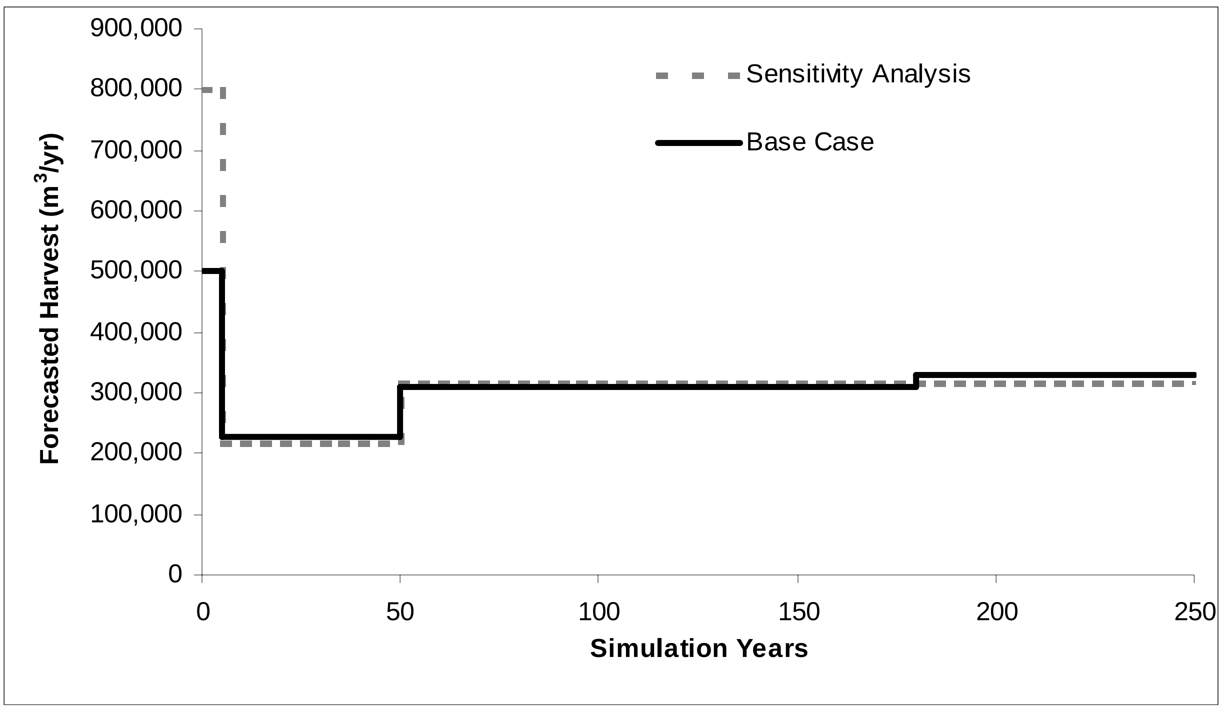

Figure 4 – Base case and a sensitivity analysis run for 800,000 m^3 initial harvest. Source: IFS 2004

2.3 Silviculture History:

The following provides a brief description of the basic and intensive silviculture practices that have taken place in TFL 53 over the last twenty years:

2.3.1 Basic Silviculture Practices

Site Preparation- TFL 53 has seen a number of site preparation techniques practiced on a variety of sites. Historically, prescribed burning was used. The use of burning has ceased in recent years due to concerns over air quality and increasing liabilities.

Mechanical site preparation (mounding and piling) is still used today, but this activity is generally restricted to specific sites, soil types, and slash conditions.

Reforestation- The licensee, over the last 20 years, has relied heavily on artificial regeneration as the primary tool for reforestation. Pine, spruce, balsam and Douglas- fir are the leading planted species in the TFL. Dunkley plants densities to target stocking levels of 1600 stems per hectare on most sites.

Brushing- Manual and chemical brushing techniques are used throughout the TFL. Manual treatments include: bend and snap, girdling, and slashing. Chemical treatments include foliar (manual/ aerial) applications.

2.3.2 Intensive Silviculture Practices

Spacing- Juvenile spacing and manual brushing treatments are typically combined under one treatment. This way the licensee is able to mange both conifer release and density management most cost effectively. The licensee reports 3,150 hectares of powersaw and 500 hectares of girdling treatments under FDRA, FRBC, and FIA programs.

Pruning- 200 hectares of pruning have been completed in the TFL.

Fertilization- There have been ongoing fertilization programs in the TFL as shown in the following table.

Table 3 – TFL 53 FIA Activities since 2002

	2002	2002	2003	2003	2004	2004	2005	2005
Activity	**Area (ha)**	**$**	**Area (ha)**	**$**	**Area (ha)**	**$**	**Area (ha)**	**$**
Brushing	444	118,128	185	126,366	0	0	0	**0**
Planting	0	0	0	0	0	0	0	**0**
Fertilization	218	90,923	162	70,588	0	0	3,421	**1,416,352**
Spacing	0	0	0	0	0	0	0	**0**
Surveys	217	4,592	64	2,615	0	0	0	**0**
Total		**213,643**		**199,569**		**0**		**1,416,352**

3 Timber Resources

Based on the 2005 timber supply analysis and review, the elevated TFL 53 harvest level through 2008 will likely permit Dunkley Lumber Ltd. to harvest the majority of the attacked or at-risk pine - leading stands on the tree farm. Following this period the harvest level will decrease towards historic levels and activities will focus more on mixed wood and spruce - dominated sites.

In spite of the accelerated short-term harvest, the recent timber supply analysis predicts that almost 1.1 million m^3 of pine (approximately 3,000 ha) will remain unsalvaged. Approximately 700,000 m^3 of this volume cannot be salvaged due to management constraints, while the rest is located in mixed stands making salvage difficult. These non-recoverable losses will remain scattered throughout the license, typically in small patches or distributed throughout non - pine leading stands. It is the licensee's desire to continue to manage some of these sites with the intention of maintaining the maximum productivity of the TFL.

This section of the report investigates issues that are considered important for the purpose of developing a meaningful silviculture strategy.

3.1 Summary of Key Issues Affecting Timber Resources

- Health of Mature Non-pine Leading Stands
- Non-Recoverable Losses
- Future Markets for Forest Products
- Minimum Harvest Criteria and the Future Unbalanced Age Class Distribution
- Health and Quality of Existing Managed Stands
- Fire Hazard and Protection
- Basic Silviculture Practices

Non-Key Issues that were discussed at the workshop

- Backlog (NSR and Impeded)
- Other Issues

3.1.1 Health of Mature non-pine leading Stands

After the MPB-related salvage is finished, most of the harvest will depend on mature stands of non-pine species. Increased reliance on non-pine species may present further risks due to other forest health agents that affect these species. For example, spruce bark beetle, balsam beetle, and Douglas- fir bark beetle have reportedly attacked portions of the TFL. According to the licensee, there are currently no significant epidemics, outside of the MPB, requiring mitigation. However, the significance of non-pine forest health issues and associated mitigation strategies must be considered to ensure that the assumed mature non-pine volume will be available in the future.

3.1.2 Non-Recoverable Losses (NRL)

Based on the recent timber supply analysis and MPB projections, 3000 - 3500 ha of severely or moderately attacked timber within TFL 53 will remain unsalvaged in spite of increased harvest levels. For this report, unharvested dead stands are considered non-recoverable losses (NRLs). These NRLs will occur mostly due to conservation uplift/biodiversity constraints. Operational logistics in harvest scheduling and accessing the dead stands have a smaller impact on creating NRLs. The following briefly discusses the causes of NRLs and strategies to deal with them.

- Areas left for biodiversity/conservation uplift.

  These areas contribute significantly to NRLs in the TFL. They cannot be salvaged due to legislated or policy driven biodiversity and conservation constraints.

- Other constrained areas such as known scenic areas.

  These areas are constrained from harvesting due to their scenic value. Some salvage is likely possible in these areas using a variety of harvesting techniques, such as partial harvesting and helicopter harvesting.

- Minor pine components of mixed stands.

  NRLs can be from pure pine-leading stands to mixed stands with the non- pine volume below the merchantable criteria. The mixed stands, depending on the distribution of pine within each stand, may present only limited opportunities for rehabilitation. Particularly, stands with a component of pine dispersed throughout, may not be possible to rehabilitate.

- Young pine plantations that are not merchantable.

  Young pine plantations that are attacked by the MPB suffer losses as well. These losses are not great in terms of their current volume; however, the loss of individual trees or in some cases whole plantations will reduce the volumes that the timber supply depends on in the future. It is a priority to survey these plantations and reforest any that have been rendered unproductive due to the MPB attack.

- Operational logistics.

As Dunkley is committed to salvaging as much dead pine as possible, operational logistics are not a major contributor to NRLs in the TFL. Dunkley's use of helicopter logging minimizes operational logistic constraints.

NRLs might be significantly larger unless the salvage is efficiently scheduled to target the appropriate dead and dying pine stands relative to "shelf life". Dunkley Lumber Ltd. currently estimates shelf life to be four years in the TFL. The recent AAC uplift reflects Dunkley Lumber's aggressive approach to schedule harvest of impacted stands given the short self-life of the timber, which should help to minimize NRLs.

The licensee generally agreed there would be a limited amount of NRLs in TFL 53. However, it is unclear where these areas will be. Several factors contribute to this uncertainty:

- The licensee is trying to best take advantage of the salvage opportunities. All decisions regarding which stands may not be harvested have not yet been made.

- Licensee customers often require a component of non- pine (e.g., Douglas-fir or large spruce) species therefore making it difficult for the licensee to harvest only pine stands when presented with this sales opportunity.

- Access to dead pine stands may be lacking or the costs maybe too high.

It is the licensee's intent to develop survey and reforestation strategies to identify NRL areas and to cost effectively restore them to full productivity.

3.1.3 Future Markets for Forest Products

What can and will be produced from northern interior forests in the future is difficult to forecast. However, these predictions are important when assessing the prospects of future timber supply and determining appropriate incremental investments.

Throughout history, the B.C. forest industry has adapted by applying new technologies to produce products from a changing forest resource. The northern interior forest industry now produces solid wood products from smaller logs than ever before. It has also made a switch into producing more non-solid wood products such as medium density fiber board (MDF) and oriented strand board (OSB). Recently, several companies have won licenses to harvest beetle infested and dying stands to produce OSB and biofuels. While these plants are being established to utilize salvage material, they will eventually be looking to secure fiber from green sources as well, once the MPB infestation is over.

When considering how industry will respond to the post-MPB wood supply, it is useful to look at forest operations in similar forest types in other parts of the world, such as in Scandinavia. There, some smaller wood can be economically utilized from thinning of plantations established at higher initial densities. In this way forest managers have more options to decide what products are eventually produced from the forests.

Many forest products experts speculate that future timber product values will be based more on basic wood properties such as specific gravity, knots sizes, fibre length, stiffness etc. than on traditional criteria such as piece size. In addition, the abundance of small timber, which will make up a significant portion of the growing stock in the mid-term, will provide a strong incentive for the forest industry to develop uses for this wood. These developments challenge our traditional views of timber supply management.

It is certain that the stands of today will be heavily relied upon in the future. These stands will be required to provide high yields of high quality products. This does not mean that silviculture regimes should be biased towards improving the quantity of timber supply. However, it does suggest that silviculture investments should be designed to generate and maintain options for the future.

3.1.4 Minimum Harvest Criteria and the Future Unbalanced Age Class Distribution

Minimum harvest criteria (MHC) are primarily forest-modeling concepts without real operational applications; stands are usually harvested when they are considered operable (economically merchantable) regardless of their age. MHC must be considered in the context of managing the challenges facing the future timber supply for the TFL. Assumptions about future markets and operating costs have the biggest potential to impact future merchantability and therefore MHC. On the other hand, MHC can have a significant impact on timber supply analysis results and actual future harvest levels.

MHC used for the recent timber supply analyses were the MOF’s Regional Priority Cutting Ages (81 for pine, 101 for spruce, 111 for Douglas fir and 121 for Balsam fir). The minimum harvest criterion for pine was lowered to 61 years due to the MPB infestation and related salvage efforts. A sensitivity analyses for TFL 53 indicated that mid-term harvest levels could benefit from a more sophisticated, flexible approach to MHC. Lowering the minimum harvest age by 5 years increased the mid term timber supply by 10%. Current trends of increasing utilization of smaller logs for non-solid wood products indicate opportunities to relax MHC in the future.

MHC are expected to be important in managing mid-term timber supply constraints such as adjacency, green-up and visual quality in MPB-impacted management units such as TFL 53. In these units, large areas of similar aged stands will result from the reforestation of this MPB infestation. In order to minimize the mid-term timber supply impacts, some of these stands will need to be harvested as soon as they are economically merchantable so that not too many stands are harvested well past culmination age. On the other hand, significant harvesting of stands below culmination age would have a long-term negative impact on timber supply.

Finally, stand-level analyses of intensive silviculture investments such as fertilization show justification for reducing harvest ages for treated stands.

3.1.5 Health and Quality of Existing Managed Stands

The timber supply in the mid-term is heavily dependent on harvesting currently young, managed stands. Many of these stands are pine - leading. Over the last few years the licensee has observed MPB infestations in immature pine leading stands. Currently the magnitude and frequency of the attack is uncertain. Given the assumption in the current timber supply analysis that only Pl >60 years old will be attacked, any significant mortality of younger pine will have an adverse effect on the mid-term timber supply. In TFL 53 this area is estimated at 1,800 ha, some of which has been juvenile spaced.

As a result of the uncertain MPB impacts on young pine, incremental silviculture treatments on these stands have been postponed until the current MPB epidemic passes.

The licensee did not express major concerns over other forest health issues (non - MPB) in young stands throughout the tree farm. While these disease and pest levels are currently at endemic levels in the TFL, surrounding management units have seen a notable increase of stem rusts in immature pine (both natural and managed stands). Rusts such as Endocronartium spp. (gall rust) appear to be having negative effects on both stand productivity and wood quality of pine in these areas. These localized occurrences may reflect local climatic conditions and reforestation practices. Even if these young pine stands survive the current MPB epidemic, this forest health issue may impact timber supply and merchantability in the mid-term.

The timing and magnitude of silviculture investments in these immature stands could have significant positive timber supply impacts. They are potential opportunity areas to improve the mid term timber supply.

Inventory of the existing managed stands to confirm suitable quality (not too open grown with poor wood quality) and health (not afflicted by significant forest health agents) for silviculture investment is important. An assessment of the risks associated with future pest losses is also required. These assessments, particularly in non-pine stands, should begin right away with health inventories of pine stands to be done after the current MPB epidemic.

3.1.6 Increased Fire Hazard and Protection

Some experts feel there will be a significant increase in the landscape-level fire hazard due to the current MPB epidemic. This is an important consideration in forest planning and when developing silviculture investment strategies.

The fire hazard depends on the Natural Disturbance Type (NDT) of the area, climate, and the amount of fuel on the forest floor.

The following photographs illustrate the conversion of historic mixed severity fire regime to a stand replacement fire regime. These changes are a result of natural and man - caused influences. Many of the forests in the northern interior are currently experiencing similar changes irrespective of the current MPB epidemic.

Photo 1 – Mixed-Severity Fire Regime

Photo 2 – Stand Replacement Fire Regime

The trend in the development of fire hazard in the mountain pine beetle killed, unsalvaged areas is expected to be as follows.

After the initial MPB attack, pine - leading stands will be subject to an increasing fire hazard: as the green needles turn red and the moisture content of the trees begins to decrease, the hazard rises. As the red needles fall from the trees over the following few years, the hazard decreases towards normal levels.

As witnessed in the southern Chilcotin (Chilco Lake fire in 2003), the fire hazard will increase slowly 5 to 20 years after the beetle attack: the dead stands begin to collapse to the forest floor in a random orientation. The development of this surface fuel fire hazard, concurrent with the regeneration of new conifers, creates a complex fire hazard (Photo 1and Photo 4). The resulting fires are often difficult to control and may lead to catastrophic fires (Photo 5).

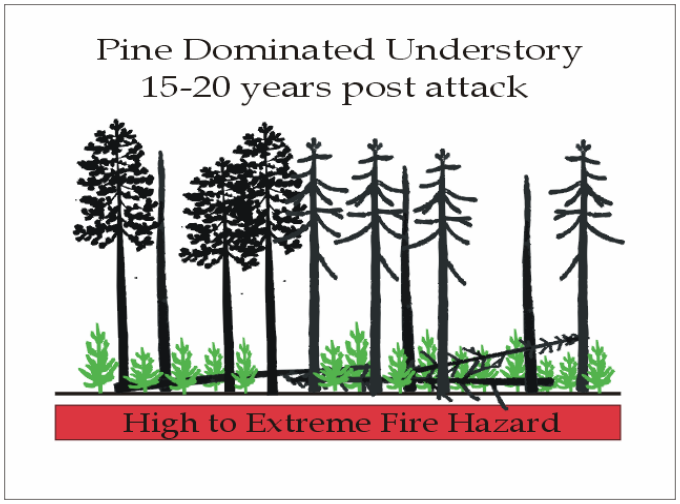

Photo 3 – Complex Fire Hazard 1

Photo 4 – Complex Fire Hazard 2

Photo 5 – Chilco Lake Fire 2003 (30,000 ha MPB in 1983)

Wildfires not only threaten public and private property, and life, but also put at risk existing mature and immature timber. In addition, fire threatens past and present silviculture investments. It is therefore prudent to consider the evolving fire hazard in the context of the MPB infestation and in silviculture investment planning.

Fire hazard mitigation should be an integral part of NRL suite of strategies. The use of prescribed burning, the development of fuel breaks and coordinated harvest planning (salvage) should all be considered within this process.

The licensee believes that the risks to timber, non - timber, and community resources are high. The proximity of TFL 53 to the communities of Hixon and Strathnaver highlight the company's concerns. Policy changes are necessary to bring prescribed burning back as a forest management tool. In addition, consultation with the public will be required.

Finally, it should be noted that evolving Community Wildfire Protection Plans might have an impact on silviculture practices and objectives within the Wildland-Urban Interface (generally defined as a zone with a width of 2 kilometers outside the municipal, city or regional district boundaries).

Within this interface licensee foresters will be challenged to meet both the needs of community protection and the TFL silviculture objectives. Website link below contains further information.

www.for.gov.bc.ca/protect/FuelManagement/CWPP.htm

3.1.7 Basic Silviculture

The success of basic silviculture is critical to future timber supply. Basic silviculture also lays the foundation for tomorrow's incremental treatments. For these reasons, an assessment of basic silviculture practices and their success was included in the workshop.

The workshop participants discussed initial stocking densities, free growing densities and species composition. Dunkley Lumber Ltd. has aggressively managed its basic silviculture obligations in TFL 53. This is evidenced by the licensee's consistency in practicing the following:

- The prompt planting of all harvested sites and the attempt to utilize the best microsites;
- Planting densities that are consistently above standard target stocking levels;
- Establishment of mixed species plantations;
- The use of A - seed when available;
- Diligent brushing practices.

3.1.8 Backlog Stands (NSR and Impeded)

In the context of managing a tree farm faced with the impact of the MPB, failure to identify and manage Backlog NSR and Impeded stands could lead to additional downwards pressure on the mid- term timber supply. Treatments on these sites also compete against NRL treatments for scarce incremental funding resources. Therefore, the identification, evaluation and treatment prioritization of these areas are important management considerations.

The licensee estimates that there are up to 800 hectares of backlog NSR in TFL 53. All of this area has been surveyed. Of the surveyed area approximately 300 hectares have the potential to be reforested while the remainder is to be reclassified and assigned a new yield curve. Added to these totals there are approximately 50 hectares of non - status roads that are considered suitable for rehabilitation and reforestation.

The licensee has also surveyed the majority of its backlog – impeded stands. It is estimated that there are approximately 400 hectares of potentially treatable area over then next 10 years.

The reforestation and release of backlog NSR areas and impeded areas is currently seen as a medium priority in the TFL. However, if the on-going surveys identify prime candidate treatment areas these could be considered for incremental funding.

4 Development of Timber Resources Strategies

4.1 Opportunities to Mitigate Timber Supply Impacts of the MPB Epidemic

It is difficult to thoroughly assess the opportunities to mitigate the MPB impacts through incremental silviculture without a forest level incremental silviculture analysis (Type 2). However, the timber supply analysis by IFS tested the sensitivity of the timber supply to several factors. These sensitivity analyses can give direction on how silviculture might impact the timber supply in TFL 53 in the future.

Short Term (1-10 years)

In the very short term, there are exceptionally high harvest volumes available in the TFL, as licensee is dealing with the task of salvaging large amounts of beetle killed pine stands. As such, there is a less of a need to try and increase the timber supply or mitigate the impacts of the MPB for the short term. These impacts will not be generally felt until 7 to 10 years from now. Most of the timber supply impacts are related to the medium term. Note that we define short term as 1-10 years due to the MPB dynamics.

Medium Term (11 – 100 years)

The medium term timber supply in the TFL will be reduced significantly from the current AAC of 800,000 m^3. However, this reduction is not a catastrophic crash of the timber supply, which is predicted to stay at a reasonable level of 219,000 m^3 per year before increasing to 315,000 m^3 per year at year 50.

Unsalvaged areas are predicted to be left in the TFL after the MPB epidemic is over. Prompt rehabilitation of these areas is important to mitigate against mid term harvest reductions that might occur due to devastating fires or potentially poorly performing natural stands replacing the dead pine stands.

The following impact the mid term timber supply in the TFL according to the recent timber supply analysis:

- Expand the THLB in the TFL

  If it were be possible to increase the THLB in the TFL by extending harvesting operations to areas that are currently not part of the THLB the mid term timber supply could be increased by 4%.

- Increase the growth and yield of existing stands in the TFL.

  Pine leading stands in the TFL are expected to be killed or damaged by the MPB. Any increases in the growth and yield of existing stands would be then limited to non-pine leading forests. The productivity of these forests could be improved in the short term by fertilization. A 10% increase in the growth and yield of existing stands led to a 9.7% increase in the mid-term timber supply according to the recent timber supply analysis.

- Minimum Harvest Ages

  The recent timber analysis showed that the minimum harvest ages were constraining the timber supply in the TFL. Lowering the MHAs by 5 years increased the mid-term timber supply by 10.6%. Flexibility in minimum harvest ages will be required in the future to improve the mid term timber supply.

Long Term (50 + years)

The long-term timber supply is expected to be unaffected by the MPB epidemic. There are opportunities to increase the long-term timber supply by expanding the THLB and increasing the managed stand volumes.

- Expand the THLB in the TFL; see the discussion under "Short Term"

- Increase managed stand volumes

  Managed stand volumes can be increased by using genetically improved stock and by repeat fertilizing regenerated stands. Increasing the growth and yield of managed stands by 10%, increase the long-term timber supply by 9.7% in the latest timber supply analysis.

4.2 Objectives of the TFL 53 SIS Strategy

The objectives of this silviculture strategy are:

- Mitigate the effects of the MPB epidemic on the timber supply
- Manage the fire risk to timber supply caused by the MPB epidemic
- Review Basic Silviculture Practices in the Context of the MPB Epidemic and Future risks of Pests and Diseases
- Keep all options open for the future
- Quality considerations

4.2.1 Mitigate the effects of the MPB epidemic on the timber supply

Broad strategies:

- Prompt identification and rehabilitation of NRL areas. As Dunkley expects the mature NRL areas be small in size, the emphasis will be in reforesting non-merchantable MPB impacted stands.
- Investigate the opportunity to ease some of the current constraints on salvage that that cause NRLs. In this way the damaged stands could be harvested and reforested.
- Increase the growth and yield of existing non-pine leading stands
- Increase the growth and yield of existing managed stands

The primary goal of this project is to develop incremental silviculture strategies that will help mitigate the effects of the MPB epidemic on the timber supply. Therefore, the over riding objective in this strategy is to promptly rehabilitate beetle killed stands and cost effectively increase the production of fiber on the THLB in a way that ensures that timber quality attributes such as log form, wood density, knot size/frequency etc. are not compromised.

4.2.2 Manage the fire risk to timber supply caused by the MPB epidemic

Broad strategies:

- Prompt rehabilitation of NRL areas
- Prescribed burning
- Fire breaks, general planning considering fire risk

As discussed previously in this report, large fires pose a risk to the rest of the forest, current and future silviculture investments, and communities. Prompt rehabilitation of NRL areas will reduce the fire risk. Additional tools such as prescribed burning and general planning considering fire risk are useful as well.

4.2.3 Review Basic Silviculture Practices in the Context of the MPB Epidemic and Future risks of Pests and Diseases

Risk management:

- Planting/regeneration densities
- Species composition

As discussed in Chapter 3.1.7 Dunkley's basic silviculture practices emphasize higher than required establishment densities and mixed species planting. Given the magnitude of the MPB epidemic and the challenges facing the timber supply, these basic silviculture strategies reduce the risk of future disease or pest epidemics.

Initial stocking densities and species composition are important attributes in this context, as they determine the growing stock to fill the mid term timber supply needs and provide for future intensive silviculture treatment and intermediate harvest opportunities as well. Adequate and diverse growing stock will buffer against pests and diseases.

4.2.4 Keep options open for the future

Broad strategies:

- Planting/regeneration densities
- Species composition
- Density management
- Fertilization

This silviculture strategy promotes the notion of keeping options open for the future. This notion applies to basic silviculture practices by promoting diversity within and between stands through regeneration densities and species composition. This will create a diverse wood basket and help buffer against future epidemics and fires.

Future markets for forest products are unknown. There is a trend for the utilization of smaller piece sizes, which is likely to continue or increase given the forecasted shortage of timber in the medium term. This strategy does not promote the production of volume at the expense of piece size; however, it encourages maintaining options for both piece size and biomass. This can be accomplished by ensuring adequate and diverse stocking and limiting density management to commercial thinning treatments, should the need arise later in the rotation.

Late rotational treatments are generally more justified financially than treatments in the earlier years of a stand. This holds true particularly for density management and fertilization treatments. Therefore, the concept of keeping options open is likely both a conservative and fiscally prudent approach to forest management, given the current pest and fire risks and the overall lack of financial resources.

4.2.5 Quality Considerations

Traditionally Dunkley has not defined quality as the amount of premium logs and sawlogs within the future timber supply, as has been common in other management units. Instead the focus has been on promoting full site occupancy with crop trees

In this strategy the focus continues to be in producing a *high quality timber supply – buffered from pests and fires through diversity - that can potentially provide products to different industries, such as sawmilling, pulp and paper, composite wood products, pellets etc.*

4.3 Analysis of Potential Silviculture Strategies

The following basic and intensive treatment strategies were presented to the licensee at the workshop:

- Basic silviculture strategies: planting vs. natural regeneration
- Basic silviculture strategies: initial planting densities
- Genetically improved seed
- NRL Reforestation Strategies
- Fertilization
- Density Management

The presentation of these strategies, using TIPSY 3.2 stand level modeling results and financial analysis, was intended to stimulate the discussion and review of a number of key concepts in basic and intensive silviculture planning. This was done in the context of the MPB epidemic and its impact on the TFL 53 timber supply.

4.3.1 Identified Timber Strategies

The licensee was asked to provide the consultants with additional strategies and opportunities for review and discussion. The response included:

- Non - pine retention timber strategies
- Non- status road rehabilitation/ reforestation
- Establishment of a seed orchard

Near the conclusion of the workshop the licensee was asked to rank and provide the consultants with direction on the numerous strategies. Of the compiled list the following indicates the agreed upon preferred silviculture strategies:

1. Reforestation of non-merchantable MPB impacted pine stands (young stands)
2. Fertilization
3. Backlog Stands (NSR and Impeded) and Non- status Roads

4.3.1.1 Non-Merchantable Stand Reforestation Strategy

Due to the uncertainty in the extent of the NRLs (young and mature stands), the unreliability of natural regeneration in these areas, and the challenges of artificially reforesting or protecting these areas, the licensee felt that proper inventories and strategic planning were required before large-scale reforestation could be initiated.

The licensee acknowledged that the first challenge in addressing the NRLs is to spatially identify candidate stands early to allow for cost effective planning and treatment. The workshop group felt that an *NRL survey program* is necessary to do this. The surveys will focus on non-merchantable stands, as it is expected that the NRLs in mature stands will be limited as discussed previously in this report.

Given the uncertainty surrounding the extent of treatable areas and the limited financial resources available, reforestation efforts should focus on the most valued and unconstrained sites and those that have the ability to contribute most to the future timber supply.

The prompt salvage of mature stands, and site preparation and reforestation of both mature and immature stands should be considered the primary objectives of this strategy. This will require not only creative silviculture solutions, but also innovative forest planning on the part of the licensee and government. For instance, appraisal, forest protection, and environmental (i.e. burning / air quality) policies may have to be revisited in order to achieve consistency in meeting TFL 53 NRL rehabilitation objectives.

Other key considerations in the management of unsalvaged beetle areas:

- Review of actual and expected natural infill by ecosystem
- Review of potential treatment strategies considering biological and economic feasibility and safety factors
- Analysis of seed needs to support potential artificial reforestation efforts
- Fire protection strategies
- Non - pine species retention strategies
- Development of a decision matrix for use in field assessment of NRLs

4.3.1.2 Fertilization Strategy

Forest fertilization (both aerial and manual application techniques) appears to be one of the few intensive silviculture treatment options that will provide short to mid term timber supply benefits and is marginally financially justified. By temporarily increasing the site productivity of the stand, an increase in the periodic volume increment in the stand can be realized. The cumulative growth response to fertilizer can reduce both the biological and economical ages to rotation. Periodic fertilizer applications can sustain this incremental volume gain over an extended period of time.

Until the current MPB epidemic subsides, there will not be fertilization treatments of pine-leading stands in the TFL. As a result, spruce- leading stands are the only candidates for treatment. Spruce has been demonstrated to response favorably to nitrogen fertilizer in the interior of BC, under the right conditions. For example according to TIPSY 3.2, the predicted volume gain for a 29-year-old site index 20 m white spruce stand is 18% over 10 years. Both the mature (e.g. 60-80 years of age) and immature spruce stands (e.g. 20-60 years of age) are candidates for fertilization.

Since 2002, over 3,800 hectares have been aerially fertilized. It is the intent of the licensee to repeatedly fertilize up to 11,000 hectares over the short term. The following stand selection criteria are currently being used to identify candidate stands for fertilization:

Table 4 – Stand selection guide for forest fertilization –MOFR, 2005

Stand selection guide for forest fertilization – 2005

Consider a stand's site conditions, health, biodiversity and potential for integrated resource management in the selection process. Stand level activities should be consistent with forest level objectives. Evaluate candidate stands according to biological factors. Those stands that are biologically acceptable should then be checked for operational feasibility to ensure they can indeed be treated and are suitable for treatment.

Species preference: Douglas-fir and spruce.

Age preference:

Age	Priority
40-79	1
15-39	2

Site index:
Douglas-fir responds on all sites.
Spruce, select sites with SI in the range from 15 to 24. Avoid sites poorer than SI =15 or SI greater than 24.

The live crown of the crop trees is greater than 30%, to utilize the added nutrients. This may be dominant and co-dominant trees or a spaced or thinned stand.

There should be room for crowns to expand, and the stand should be fully stocked.

The height/diameter breast height (dbh) ratio for Douglas-fir should be less than 85. Avoid fertilizing conifer stands with a height/dbh ratio greater than 100.

The following four operational factors should be considered during the evaluation of candidate stands.

Location: Choose sites closest to communities as distance to haul the fertilizer affects transportation costs. Also, costs of future harvests are partly determined by hauling distances to manufacturing plants and markets.

Access: Conditions of access also affect costs of transporting material and personnel in fertilizer operations, in addition to later expenses of hauling timber to manufacturing plants. Avoid areas, which require ferry flights longer than 2km.

Slope: Costs of future management and harvesting usually increase as terrain becomes steeper. Furthermore, flying over steep or irregular, contoured land may not be conducive to efficient and uniform aerial distribution of fertilizer.

Project and Block Size**: Project and block sizes affect efficiency and cost of operation. Large-scale programs (e.g., >300 ha) are** generally more cost effective.

4.3.1.3 Backlog Stands (NSR and Impeded) and Non- status Roads Strategy

The future of the backlog area was discussed throughout the workshop. The licensee has previously surveyed, reclassified and developed treatment options for most of this area. Up to 300 hectares could be treated with incremental funding over the planning period of 5 years. On top of this, another 50 hectares of non- status roads could be rehabilitated as well. It is estimated that the backlog survey program would continue through the next decade with about 400 hectares planned for survey activities.

4.4 Strategies to Increase the Quality and Quantity of Future Timber Supply

Table 5 - Intensive Strategies to Increase the Quality and Quantity of the TFL 53 Timber Supply

Short-term:	**Fertilize mature spruce - leading stands** to generate short-term volume gains and larger log sizes. • Aerial • Manual (for small areas with good access)
Mid-term:	**Fertilize immature spruce - leading stands** • Aerial • Manual Repeat stand treatments are preferred. Pine-leading stands should be incorporated in the ongoing review of candidate stands for treatment once the MPB epidemic subsides. **Reforestation of NRL sites, Non-Merchantable Stands Priority** Ensure the prompt regeneration of all NRL sites. An *NRL survey program* would identify problem sites and result in the prioritization of treatment areas. Other management considerations should include: • Actual and expected natural infill by ecosystem • Potential NRL treatment strategies considering biological, economic, feasibility and safety factors • Seed needs to support potential artificial reforestation efforts • Fire protection strategies • Non- pine species retention strategies • Potential development of a decision matrix for use in field assessment of NRL's **Backlog Surveys** • Continue implementation a TFL 53 Backlog Survey program to identify treatment opportunities and to monitor effectiveness **Backlog- NSR treatments** • Implement cost effective backlog – NSR treatments as required **Backlog- Impeded Stand treatments** • Implement cost effective backlog – impeded stand treatments as required. **Non- Status Roads treatments**

	• Rehabilitate and reforest previously identified non- productive roads **Establish a seed orchard to produce genetically improved pine seed.** (not included in the budget below)

Table 6 - Basic Strategies to Increase/Maintain the Quality and Quantity of Future Timber Supply

Mid Term/Long Term	**Continue to minimize the current NSR by quick planting after harvesting.** **Continue to use site preparation where needed to create plantable spots and improve rooting conditions for the planted seedlings.** **Continue to use seed orchard stock for all spruce seedling requirements.** **Continue to plant high densities with mixed species (1,800 – 2,000 sph)** • Provide high site occupancy and high potential for growing wood fibre. • Reduce risk of plantation failure. • Create opportunities for commercial thinning. **Continue to use effective timely vegetation management to promote better survival and growth of seedlings.**

5 Five Year Incremental Forestry Program

This section outlines and summarizes a recommended fundable TFL 53 incremental silviculture program.

Table 7 - Proposed Treatment Areas

Activity	Rank	Year 1 ha	Year 2 ha	Year 3 ha	Year 4 ha	Year 5 ha	Total ha
NRL Reforestation Surveys	A	500	500	1,000	1,000	0	3,000
NRL (young stands) Reforestation	A	0	0	500	500	500	1,500
Fertilize- mature spruce	A	200	200	200	200	200	1,000
Fertilize- immature spruce	A	1,000	1,500	1,500	1,500	1,500	7,000
Backlog - Surveys reclassification or treatment scheduling	B	0	0	0	0	300	300
Backlog- Impeded treatments	B	0	50	50	50	50	200
Backlog- NSR treatments	B	0	0	0	0	0	0
Non- status Road Treatments	C	50	0	0	50	0	50
Establish a Seed Orchard for Pine	C						
Total ha		1,700	2,250	3,250	3,300	2,550	13,050

Table 8 - Proposed Budget

Activity	Rank	Year 1 $	Year 2 $	Year 3 $	Year 4 $	Year 5 $	Total $
NRL Reforestation Surveys	A	5,000	5,000	10,000	10,000	0	30,000
NRL (young stands) Reforestation	A	0	0	500,000	500,000	500,000	1,500,000
Fertilize- mature spruce	A	85,000	85,000	85,000	85,000	85,000	425,000
Fertilize- immature spruce	A	425,000	637,500	637,500	637,500	637,500	2,975,000
Backlog - Surveys reclassification or treatment scheduling	B	0	0	0	0	9,000	9,000
Backlog- Impeded treatments	B	0	40,000	40,000	40,000	40,000	160,000
Backlog- NSR treatments	B	0	0	0	0	0	0
Non- status Road Treatments	C	0	0	0	170,000	0	170,000
Establish a Seed Orchard for Pine	C						
Total $		515,000	767,500	1,272,500	1,442,500	1,271,500	5,269,000

Table 9 - Job Outcomes

Activity	Priority	Year 1 Person Days	Year 2 Person Days	Year 3 Person Days	Year 4 Person Days	Year 5 Person Days	Total Person Days
NRL Reforestation Surveys	A	10	10	20	20	0	60
NRL (young stands) Reforestation	A	0	0	1,000	1,000	1,000	3,000
Fertilize- mature spruce	A	20	20	20	20	20	100
Fertilize- immature spruce	A	100	150	150	150	150	700
Backlog - Surveys reclassification or treatment scheduling	B	0	0	0	0	60	60
Backlog- Impeded treatments	B	0	125	125	125	125	500
Backlog- NSR treatments	B	0	0	0	0	0	0
Non- status Road Treatments	C	0	0	0	80	0	80
Establish a Seed Orchard for Pine	C						
Total (person days)		130	305	1,315	1,395	1,355	4,500

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Appendix

Coniferous Log Values Used in the Stand-level Analysis for the TFL53 SIS Update (Jan 2006)

The following tables present 'Base', 'Steep' and 'Flat' log prices for each of the species used in the analysis. Prices are FOB at the mill. 'Base' prices approximately represent the average current prices. 'Steep' prices assume future higher premiums for larger logs. 'Flat' prices assume less than current premiums for larger logs.

Table 10 – Coniferous log values used at workshops

SPF

		Peeler/ House log	S/L	Pulp
Set 1	Current	$70	$45	$28
Set 2	Steep	$90	$45	$28
Set 3	Flat	$50	$45	$28

Silviculture Treatment Costs and Employment Assumptions

Table 11 – Treatment costs and employment assumptions used at Northern Interior workshops

Silviculture Treatment	Cost ($) Low		Cost ($) Base		Cost ($) High		Employment (days/ha)
	$/ha	$/unit	$/ha	$/unit	$/ha	$/unit	
Surveys (Regen and FTG)	80	-	120	-	160	-	0.2 to 0.4
Site Preparation		-		-		-	1 to 2.3
Drag (for natural regen.)	150		175		200		
Burning (for natural regen. Low and base are for slashburning. High is for burning NRL's)	400		700		1000		
Mounding and Disc Trenching (for planting)	300		500		700		
Chemical (for planting)	275		400		600		
Planting (per tree including seedlings and planting; low= low genetic worth seed with prep. med= low genetic worth seed with no prep., high= high genetic worth seed with no prep.)		0.44		0.54		0.56	1 to 2
Planting of NRL's		0.54		1.00		1.40	1 to 2
Fill Planting (including seedlings)	400	-	600	-	700	-	1 to 2
Brushing (Low is for chemical- aerial, base is for chemical-ground, high is for manual)	350	-	450	-	650	-	1 to 2.5
Aerial Fertilization (costs per treatment)	250	-	375	-	450	-	0.1
Manual Fertilization (costs per treatment)	250	-	375	-	450	-	1 to 1.5
Juvenile Spacing	400		600		800		1 to 2